FACULTY OF MECHANICAL ENGINEERING KRALJEVO
UNIVERSITY OF KRAGUJEVAC
KRALJEVO – SERBIA

THE SEVENTH INTERNATIONAL TRIENNIAL CONFERENCE

HEAVY MACHINERY
HM 2011

PROCEEDINGS

Vrnjačka Banja, June 29th – July 2nd 2011.

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ORGANIZATION SUPPORTED BY:

Ministry of Education and Science, Republic of Serbia

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PUBLISHER:
Faculty of Mechanical Engineering, Kraljevo

EDITORS:
Prof. dr Novak Nedić, mech. eng.

PRINTOUT:
SaTCIP d.o.o. Vrnjačka Banja

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No. of copies: 200

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PREFACE

The Faculty of Mechanical Engineering Kraljevo has been traditionally organizing the international scientific conference devoted to heavy machinery every three years. The VII International Scientific Conference HM 2011 is considering modern methods and new technologies in the fields of transport design in machinery, control energy, production technologies, urban engineering and civili engineering through thematic sessions for the purpose of sustainable competitiveness of economic systems. Modern technologies are exposed to fast changes at the global world level so that their timely application both in large industrial systems and in medium and small enterprises is of considerable importance for the entire development and technological progress of economy as a whole.

The VII International Scientific Conference Heavy Machinery HM 2011 is a place for exchange of experiences and results accomplished in domestic and foreign science and practice, with the goal to indicate directions of further development of our industry on its way toward integration in european and world economic trends. Exchange of experiences between our and foreign scientific workers should contribute to extension of international scientific-technical collaboration, initiation of new international scientific-research projects and broader international collaboration among universities.

The papers which will be presented at this Conference have been classified into seven thematic fields:

A. Railway Engineering
B. Earth-Moving and Transportation Mechanization
C. Automatic control and fluid technique
E. Mechanical Design and Mechanics
F. Production Technologies
G. Urban Engineering
H. Structures And Materials In Civil Engineering

Within this Conference, the First International Students Symposium will be held. The aim is to open a scientific discussion on this actual problem in industry among young students.

The sponsorship by the Ministry of Science of the Republic of Serbia is the proper way to promote science and technology in the area of mechanical engineering in Serbia.

On behalf of the organizer, I would like to express our thanks to all organizations and institutions that have supported this Conference. I would also like to extend our thanks to all authors and participants from abroad and from our country for their contribution to the Conference. And last but not the least, dear guests and participants in the Conference, I wish you a good time in Kraljevo – Vrnjačka Banja and see you again at the Eight Conference, in three years.

Kraljevo – Vrnjačka Banja, June 2011

Conference Chairman,

Prof. Dr Novak Nedić, mech eng.

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E SESSION: PRODUCTION TECHNOLOGIES

F SESSION: URBAN ENGINEERING

G SESSION: STRUCTURES AND MATERIALS IN CIVIL ENGINEERING

HEAVY MACHINERY - HM 2011, 63-66 Paper accepted: 25.05.2011
ISBN 978-86-82631-58-3

Some linearity characteristics for homogeneous Vekua equation with analytical coefficients

Jelena Vujaković[1,*]- Miloje Rajović[2]
[1] University of Priština, Faculty of Sciences and Mathematics, Lole Ribara 29, 38 200 Kosovska Mitrovica, Serbia
[2] University of Kragujevac, Faculty of Mechanical Engineering, Dositejeva 19, 36 000 Kraljevo, Serbia

There are very little data in literature about Vekua equations with analytical coefficients. That is why they present an interesting area of scientific work. It is known (see [1-6]) that they have been solved by analytical substitution method or by a series-iteration method. Basis for these methods is the principle of fixed point.

In this paper we have presented that homogeneous Vekua equation, with analytical coefficients, is only apparently linear. Actually, it is typically transcendental equation.

Keywords: Conjugate derivate, analytical functions, Vekua equation, a series iteration method.

0 INTRODUCTION

Equation

$$\frac{\partial w}{\partial \bar{z}} = Aw + B\bar{w} \tag{1}$$

where $A = A(z,\bar{z})$ and $B = B(z,\bar{z})$ are analytical functions in certain finite region G, is called homogeneous Vekua equation. Operation $\frac{\partial w}{\partial \bar{z}}$, denoting conjugate derivative,

$$\frac{\partial w}{\partial \bar{z}} = \frac{1}{2}\left[\left(\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y}\right) + i\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right)\right] \tag{2}$$

is linear, so is applicable

$$\frac{\partial}{\partial \bar{z}}(w_1 \pm w_2) = \frac{\partial w_1}{\partial \bar{z}} \pm \frac{\partial w_2}{\partial \bar{z}}$$

$$\frac{\partial}{\partial \bar{z}}(cw_1) = c\frac{\partial w_1}{\partial \bar{z}}, c = const.$$

Conjugate derivative is very similar to ordinary derivative, so the operational rules for product, quotient are easy to perform, as well as the rules for conjugate derivatives of elementary complex or conjugate complex functions.

If in equation (1) coefficient is $B = 0$, then equation (1) is called Theodoresku equation.

With these rules it can be easily transferred to reverse operation to conjugated derivative, that is, integral $\hat{\int}$. In order to more relate this integral to ordinary integral, we are introducing sign

$$\hat{\int} F(z,\bar{z}) = \int F(z,\bar{z})\, d\bar{z} + \phi(z),$$

where $\phi(z)$ is arbitrary analytical function in the role of integral constant. This is not line integral, but symbolic record that is necessary to integrate only by one variable $\bar{z}$, considering second variable z as a constant.

Due to these characteristics, derivatives and integrals, solving of equation (1) was reduced to procedures very similar to solving of ordinary differential equations with real argument. Main difference is because the main role of the ordinary constant here is taken over by arbitrary function $\phi(z)$.

In monograph [1] was pointed out the importance of this equation in mathematical physics. Many boundary problems have been solved there. It is interesting that Vekua [1-2], solves equation where coefficients $A = A(z,\bar{z})$ and $B = B(z,\bar{z})$ do not have to be analytical functions, but are some function of the space $L_p(G), p > 2$, where G is finite closed region.

In the lines [2-6] are given new, but abbreviated and more practical formulas for solving of equation (1), providing A and B are analytical functions in finite region.

Among other things, it has been shown that general solution of homogenous Vekua equation (1) with analytical coefficients, $w = w_{A,\phi} + w_{B,\phi} + w_{A,B,\phi}$, contains part which only

*Corr. Author's Address: Faculty of Sciences and Mathematics, Lole Ribara 29, 38 200 Kosovska Mitrovica, Serbia, enav@ptt.rs